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Presents facts and comparisons on earned degrees for the 11-year period 1949–50 through 1959–60 in the biological sciences, the physical sciences, mathematics and statistics, nd engineering. Includes statistical tables and charts. Data were derived from annual reports of the Office of Education entitled *Earned Degrees Conferred: Bachelor's and Higher Degrees.*

Articles by Dr. Lindquist dealing with earned degrees in specific manpower fields have recently appeared in the following publications: *GeoTimes* (May–June 1961); *American Mathematical Monthly* (August–September 1961); *Physics Today* (January 1962); *AIBS Bulletin* (American Institute of Biological Sciences) in collaboration with E. L. Miller (February 1962); *Journal of Chemical Education* (March 1962); *AAUW Journal* (American Association of University Women, March 1962).

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Earned Degrees in Crucial Manpower Fields

By CLARENCE B. LINDQUIST*

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education
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THE EXTENT of the commitment of the Soviet Union to the production of scientists, engineers, and technicians has been carefully documented in a voluminous and extremely important study, *Education and Professional Employment in the U.S.S.R.*, prepared by Nicholas De Witt of Harvard and recently published by the National Science Foundation. The facts Mr. De Witt sets forth are sobering. He reports, for example, that in the Soviet Union about 57 percent of the bachelor's degrees earned in 1959 were in engineering, science, and applied science fields, as compared with about 24 percent in the United States, and that the Soviets are graduating two or even three times as many people in these fields as we are.

At his news conference on January 15, President Kennedy referred to the De Witt study and expressed concern that the number of our graduates in the sciences and engineering has fallen short of our needs. He said:

"This has been a matter of some concern to me for some time because one of the most critical problems facing this Nation is the inadequacy of the supply of scientific and technical manpower to satisfy the expanding requirements of this country's research and development efforts in the near future." He then stated that he had asked his Science Advisory Committee, in cooperation with the Federal Council for Science and Technology, to review available studies and other pertinent information and to report to him as quickly as possible on the specific measures that can be taken on this matter both in and out of the Government.

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One of the basic facts confronting the Committee and the Council is that, although our population during the 1950's increased substantially and the demands of our growing technology became more pressing, the number of students earning degrees in scientific and technical fields fell far short of the demand. This article, based on the annual *Earned Degrees Conferred: Bachelor's and Higher Degrees* reports of the Office of Education, presents facts and comparisons for the 11-year period, 1949–50 through 1959–60, in the biological sciences, the physical sciences, mathematics and statistics, and engineering.

Major trends.—After a sharp decline during the first half of the 1950's, the number and percentage of bachelor's and master's degrees in biological and physical sciences, mathematics and statistics, and engineering gradually but steadily increased. At the same time the number of doctoral degrees increased steadily throughout the decade, with only a slight decrease in the percentage during the mid-fifties.

The numbers and percentages of degrees for all of these fields by years from 1949–50 through 1959–60 are shown in table 1.

Bachelor's degrees.—As shown in table 1, the 83,108 bachelor's degrees awarded in science, mathematics, and engineering in 1959–60 were still considerably less than the high figure of 101,298 in 1949–50. The 1959–60 figures for the biological sciences, physical sciences, and engineering, considered separately, were substantially below those for 1949–50. Only the mathematical subjects (mathematics, statistics, and actuarial science) showed an increase. In fact, in recent years the mathematical subjects have been the most rapidly growing field among the major disciplines.

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The decline in the number of bachelor's degrees earned in science, mathematics, and engineering during the first half of the 1950's was brought about by more than one factor. First, the decline was part of a general decline in degrees earned in all subject fields, the result of the low birth rates of the 1930's, which reduced the number of college-age youth in the early 1950's. Second, the "veterans' bulge" from World War II reached its peak in graduations in 1949–50 and then began to taper off. Just at this time the Korean conflict took some young men who would normally have been in college. Finally, the decreasing popularity of the sciences, mathematics, and engineering during the first half of the fifties contributed to the reduced number of baccalaureates in these fields.

In the case of engineering, reports circulated about 1950 that there was an oversupply of engineers were undoubtedly an important factor in the sharp decrease in the number of engineering baccalaureates—from 52,732 in 1949–50 to 22,236 in 1953–54. By 1958–59 the number had risen again, but only to 38,134, and then decreased in 1959–60 to 37,808.

Master's and doctor's degrees.—Although bachelor's degrees failed to return to their former levels, some comfort may be found in the record during this period of master's and particularly doctor's degrees. The number of these degrees in 1959–60, with the exception of master's degrees in the biological sciences, in every instance exceeded the corresponding number in 1949–50. Mathematics and engineering, indeed, not only showed substantial gains in total numbers of master's and doctor's degrees but also advanced significantly in their percentages at both these levels.

Totals for the 11-year period.—To eliminate year-by-year fluctuations, I have computed totals of degrees conferred in the biological sciences, the physical sciences, mathematics and statistics, and engineering at each level for the 11-year period. (See table 2.) At the bachelor's and master's levels engineering accounted for a little less than half of the total number of degrees in science, mathematics, and engineering; at the doctoral level the physical sciences accounted for nearly half of all the doctorates conferred in these fields, primarily because of the large number of doctorates awarded each year in chemistry.

Degrees awarded to women.—In discussions of means by which our scientific manpower resources might be enlarged, attention has been devoted in recent years to the problem of attracting more women into scientific and technological careers (see table 2). Although women received nearly 1 out of 3 bachelor's degrees in all fields, they received only slightly more than 1 out of 10 of the degrees in science, mathematics, and engineering. At the master's level the corresponding figures were about 1 out of 3 versus about 1 out of 12, and at the doctoral level about 1 out of 10 versus about 1 out of 20. The biological subjects at all levels and mathematics at the bachelor's and master's levels were the most popular fields among women.

The biological sciences.—It will be noted in chart 1 that while biology, general, predominated at the baccalaureate level, the number and percentage of degrees in the various biological specializations increased at each higher level.

The 5 institutions which led the way in production of doctorates in the biological sciences for the 10-year period 1949–50 through 1958–59 were: University of California (all campuses), 960; University of Wisconsin, 720; Cornell University, 456; University of Michigan, 390; and University of Illinois, 344.

The physical sciences.—At the bachelor's level chemistry accounted for nearly half of all physical

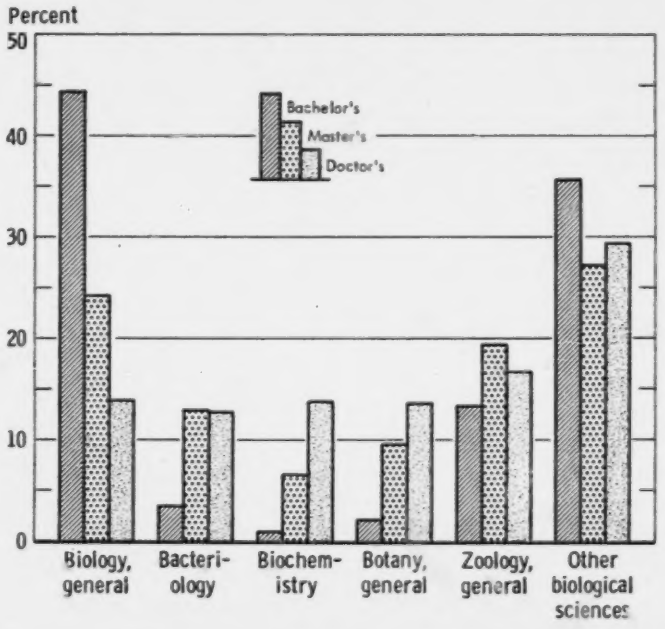


Chart 1.—Degrees awarded in selected biological sciences as percentages of the total of all degrees in the biological sciences, by level, 1949–50 through 1959–60.

Table 1.—Earned degrees conferred in the biological and physical sciences, mathematical subjects, and engineering, by level of degrees: annually, 1949–50 through 1959–60

Year ending June 30—	Number of degrees conferred					Percent of all degrees conferred at each level [1]				
	Total	Biological sciences [2]	Physical sciences [3]	Mathematical subjects [4]	Engineering	Total [5]	Biological sciences [2]	Physical sciences [3]	Mathematical subjects [4]	Engineering
	Bachelor's degree									
1950	101,298	22,521	19,653	6,392	52,732	23.4	5.2	4.5	1.5	12.2
1951	82,417	18,868	15,903	5,753	41,893	21.4	4.9	4.1	1.5	10.9
1952	63,265	15,423	12,835	4,721	30,286	19.1	4.7	3.9	1.4	9.1
1953	53,994	14,068	11,366	4,396	24,164	17.7	4.6	3.7	1.4	7.9
1954	50,905	13,580	10,993	4,096	22,236	17.4	4.6	3.8	1.4	7.6
1955	50,672	12,847	11,202	4,034	22,589	17.6	4.5	3.9	1.4	7.9
1956	56,411	13,169	12,276	4,660	26,306	18.1	4.2	3.9	1.5	8.5
1957	64,975	14,576	13,642	5,546	31,211	19.1	4.3	4.0	1.6	9.2
1958	72,908	15,354	15,298	6,924	35,332	19.9	4.2	4.2	1.9	9.7
1959	79,707	16,122	16,432	9,019	38,134	20.7	4.2	4.3	2.3	9.9
1960	83,108	16,730	17,133	11,437	37,808	21.0	4.2	4.3	2.9	9.6
	Master's and other 2d-level degrees									
1950	11,595	2,412	3,305	974	4,904	19.9	4.1	5.7	1.7	8.4
1951	12,185	2,603	3,317	1,109	5,156	18.7	4.0	5.1	1.7	7.9
1952	10,466	2,442	3,081	802	4,141	16.5	3.8	4.9	1.3	6.5
1953	9,103	1,994	2,689	677	3,743	14.9	3.3	4.4	1.1	6.1
1954	8,962	1,658	2,421	706	4,177	15.8	2.9	4.3	1.2	7.4
1955	9,515	1,668	2,602	761	4,484	16.4	2.9	4.5	1.3	7.7
1956	10,099	1,789	2,688	898	4,724	17.0	3.0	4.5	1.5	8.0
1957	10,798	1,849	2,752	965	5,232	17.4	3.0	4.4	1.6	8.5
1958	12,131	1,964	3,145	1,234	5,788	18.5	3.0	4.8	1.9	8.8
1959	13,785	2,177	3,356	1,499	6,753	19.8	3.1	4.8	2.2	9.7
1960	14,859	2,351	3,584	1,765	7,159	19.9	3.2	4.8	2.4	9.6
	Doctor's degrees									
1950	2,771	644	1,473	160	494	41.8	9.7	22.2	2.4	7.4
1951	3,217	795	1,652	184	586	43.8	10.8	22.5	2.5	8.0
1952	3,232	770	1,670	206	586	42.1	10.0	21.7	2.7	7.6
1953	3,460	968	1,659	241	592	41.6	11.7	20.0	2.9	7.1
1954	3,616	1,095	1,704	227	590	40.2	12.2	18.9	2.5	6.6
1955	3,560	996	1,715	250	599	40.3	11.3	19.4	2.8	6.8
1956	3,537	1,025	1,667	235	610	39.7	11.5	18.7	2.6	6.9
1957	3,627	1,106	1,676	249	596	41.4	12.6	19.1	2.8	6.8
1958	3,674	1,125	1,655	247	647	41.1	12.6	18.5	2.8	7.2
1959	3,859	1,048	1,815	282	714	41.2	11.2	19.4	3.0	7.6
1960	4,134	1,206	1,839	303	786	42.1	12.3	18.7	3.1	8.0

[1] For example, at the bachelor's level the percentage is based upon the total number of bachelor's and 1st professional degrees conferred that year. A double major with approximately equal concentrations in 2 disciplines is counted as ½ for each discipline.

[2] Includes premedical, predental, and preveterinary sciences; biology, general; botany, general; anatomy and histology; bacteriology, virology, mycology, parasitology; biochemistry; biophysics; entomology; genetics (including experimental plant and

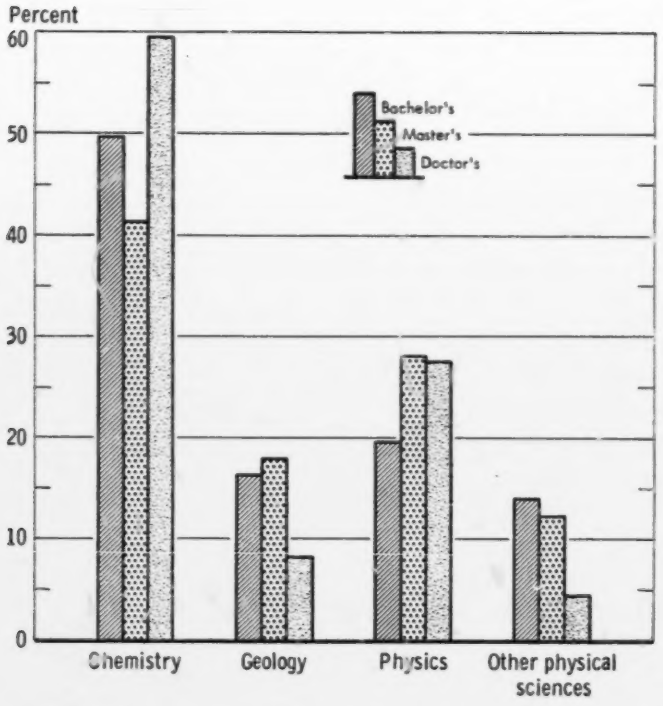


Chart 2.—Degrees awarded in selected physical sciences as percentages of the total of all degrees in the physical sciences, by level, 1949–50 through 1959–60.

science degrees, at the doctoral level for almost 60 percent (see chart 2). Only in physics, a growing field, did the numbers of degrees in 1959–60 exceed at each level the corresponding numbers for 1949–50. Chemistry declined at both the bachelor's and the master's level, but held steady at the doctoral level. After a steady increase in the later fifties, the number of degrees in geology in 1959–60 declined at both the bachelor's and the master's level.

The 5 leading producers of doctorates in the physical sciences for the 10-year period 1949–50 through 1958–59 were: University of California (all campuses), 1,085; Massachusetts Institute of Technology, 819; University of Illinois, 807; Columbia University, 598; and University of Wisconsin, 574.

Engineering.—Although mechanical engineering achieved the greatest number of bachelor's degrees for the entire period and led in the number of first-level engineering degrees for each year from 1949–50 through 1955–56, it ranked second to electrical engineering for each year from 1956–57 through 1959–60. (See chart 3.) At the doctoral level, chemical engineering was the largest field in most years, as well as for the 11-year period taken as a whole, with electrical engineering a close second.

The 5 leading producers of doctorates in engineering for the 10-year period 1949–50 through 1958–59 were: Massachusetts Institute of Technology, 686; University of Illinois, 362; University of Michigan,

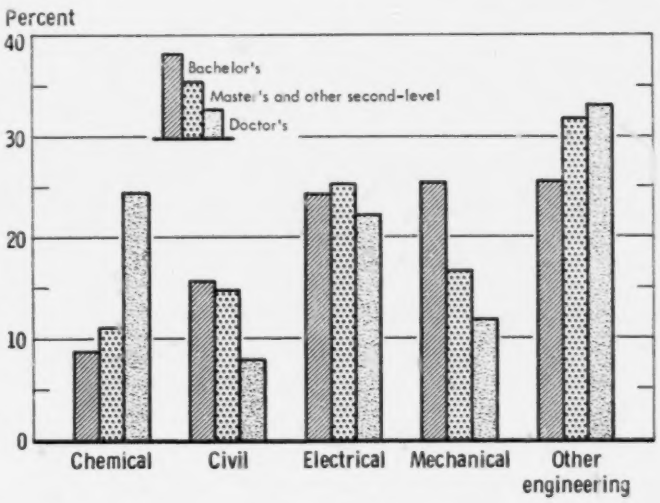


Chart 3.—Degrees awarded in selected specializations in engineering as percentages of the total of all degrees in engineering, by level, 1949–50 through 1959–60.

328; Purdue University, 324; Stanford University, 243.

Mathematics and statistics.—During the past several years, mathematics has experienced a remarkable growth at the bachelor's and master's levels. The annual numbers of formal degrees in statistics,

Continued on page 16

animal breeding); optometry (preprofessional bachelor's degree); pathology (including plant pathology); physiology (including plant physiology); and pharmacology (excluding pharmacy); excludes forestry and agricultural sciences; includes allocations from sciences, general program (without major field).

[3] Includes astronomy; chemistry (excluding biochemistry); metallurgy (beginning with the year 1953–54); meteorology; physics; geology; geophysics; oceanography; earth sciences, other; physical sciences, general major; includes allocations from sciences, general program (without major field).

[4] Includes mathematics, statistics, and actuarial science.

[5] Total does not necessarily equal the sum of components due to rounding.

Source: Earned Degrees Conferred, and Engineering Enrollments and Degrees, Office of Education, U.S. Department of Health, Education, and Welfare. Based upon revised and reallocated data. Data are for aggregate United States.

Reorganization of the Office of Education

REORGANIZATION of the Office of Education, announced at the end of February by U.S. Commissioner of Education Sterling M. McMurrin, has placed the Division of Higher Education in a newly formed Bureau of Research and Development. The Division, one of five divisions in that bureau, will be composed of two branches—Academic Affairs and Administrative Affairs. These were formerly called the Programs Branch and the College and University Administration Branch. The Financial Aid Branch, which administers the four National Defense Education Act (NDEA) programs in higher education and which formerly was in the Division of Higher Education, will be known as the Division of Institutional Grants and will be placed in the Bureau of Educational Assistance Programs.

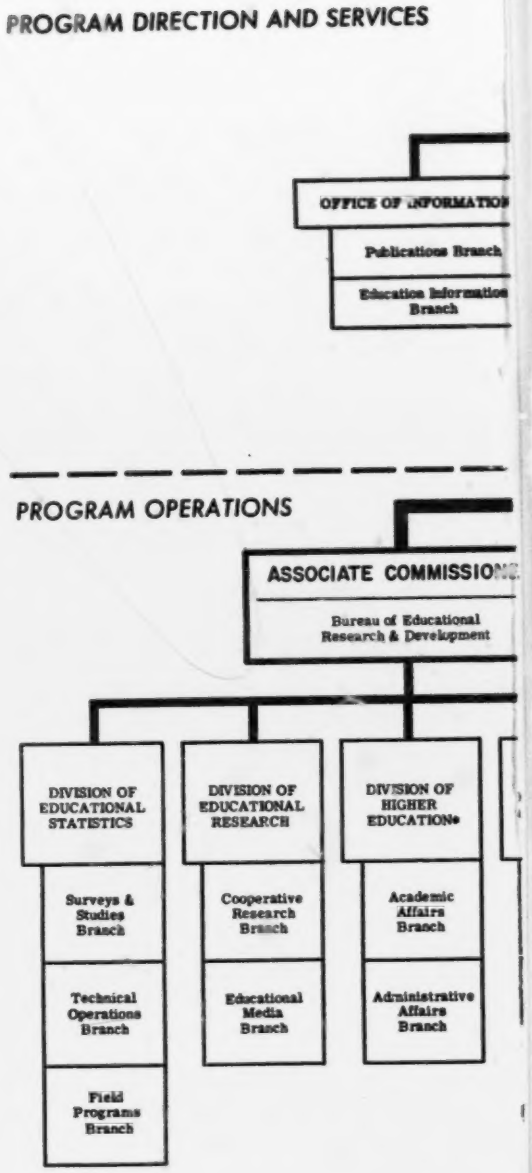
A third bureau—the Bureau of International Education—has also been established. It will administer the same programs previously administered in the Division of International Education and will include international education studies and technical assistance and teacher exchange. Each of the three bureaus is to be headed by an associate commissioner. The appointments will be announced in April.

The Bureau of Educational Research and Development combines the previous Division of Statistics and Research Services with the professional research and development activities which previously were carried on in the Divisions of Higher Education and State and Local School Systems. The bureau comprises five divisions: Educational Statistics, Educational Research (Cooperative Research and NDEA Educational Media), Higher Education, Elementary and Secondary Education, and Continuing Education and Cultural Affairs. The last of these includes branches for adult education, library services, and cultural affairs. The third branch is completely new and will be staffed in the near future.

The Bureau of Educational Assistance brings together programs concerned with or based on financial assistance at all educational levels, including Vocational and Technical Education, School Assistance in Federally Affected Areas, State Grants (titles III and V–A of NDEA) and Institutional Grants (titles II, IV, V–B, and VI of NDEA).

Four service areas continue to report directly to the Commissioner: the Office of Information, the Office of Administration, the Office of Legislative and Program Planning, and the Office of Field Services. One of the functions of the Office of Legislative and Program Planning will be to survey the effect of the various governmental programs on all levels of education; and a new branch will be established to perform that function. The Office of the Commissioner also includes a National Panel of Consultants. The panel will be composed of persons of the highest competence in various fields of importance to education; members will be available for consultation individually or in small groups.

These and other changes, Commissioner McMurrin said, have been made necessary by the new developments in



*Assistant Commissioner